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IS 1448-116 (1992): Methods of Test for Petroleum and its Products, Part 116: Determination of Cone Penetration of Lubricating Grease Using One Quarter and One Half Scale-cone [PCD 1: Methods of Measurement and Test for Petroleum, Petroleum Products and Lubricants]

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पेट्रोलियम और इसके उत्पादों की परीक्षण पद्धतियां

[पी : 116]

एक चौथाई और अर्धपैमाना कोन का उपयोग करते हुए स्नेहन ग्रीस का कोन वेधन ज्ञात करना

(पहला पुनरीक्षण)

Indian Standard

METHODS OF TEST FOR PETROLEUM AND ITS PRODUCTS

[P : 116]

DETERMINATION OF CONE PENETRATION OF LUBRICATING GREASE USING ONE QUARTER AND ONE HALF SCALE-CONE

(First Revision)

UDC 621·892·2 : 620·192·2

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NEW DELHI 110002

March 1992 Price Group 3

Methods of Test for Petroleum, Petroleum Products and Lubricants Sectional Committee, PCD 1

FOREWORD

This Indian Standard [P : 116] (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Methods of Test for Petroleum, Petroleum Products and Lubricants Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

METHODS OF TEST FOR PETROLEUM AND ITS PRODUCTS

[P : 116]

DETERMINATION OF CONE PENETRATION OF LUBRICATING GREASE USING ONE QUARTER AND ONE HALF SCALE-CONE

(First Revision)

Adapted with permission from the joint Publication ASTM Designation D 1403-90 and IP Designation 310/84

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1 SCOPE

1.1 This standard describes two procedures for measuring consistency of small samples of lubricating greases by penetration of 1/4 scale cone or a 1/2 scale cone. This test method includes procedures for the measurement of unworked and worked penetration.

1.2 Unworked penetration do not generally represent the consistency of greases in use, as effectively as do worked penetration. The latter are usually preferred for inspecting lubricating greases.

1.3 This standard may involve hazardous materials, operations and equipments. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2 REFERENCES

The Indian standard, IS 1448 [P : 60] : 1971 'Consistency of lubricating greases by cone penetrometer' is a necessary adjunct to this standard.

3 DESCRIPTION OF TERMS SPECIFIC TO THIS STANDARD

3.1 Penetration of Lubricating Grease

The depth in units of 0·1 mm that a 1/4 scale cone or 1/2 scale cone penetrates the sample under prescribed conditions of mass, time and temperature.

3.2 Working

The subjection of lubricating grease to the shearing action of the 1/4 scale or 1/2 scale grease worker.

3.3 Unworked Penetration

The penetration at 25°C of a sample of lubricating grease that has received only minimum disturbance in transfer to a 1/4 scale or 1/2 scale grease worker cup or dimensionally equivalent rigid container.

3.4 Worked Penetration

The penetration of a sample of lubricating grease that has been brought to 25°C subjected to 60 double strokes in a 1/4 scale or 1/2 scale grease worker, and penetrated without delay.

4 OUTLINE OF THE METHOD

The penetration is determined at 25°C releasing the 1/4 scale or 1/2 scale cone assembly from the penetrometer and allowing the cone to drop freely into the grease for 5 seconds.

5 SIGNIFICANCE AND USE

5.1 This test method is applicable to greases of National Lubricating Grease Institute (NLGI) consistency numbers 0 to 4 and is intended for use only where the size of the sample limits the use of IS 1448 [P : 60] : 1971.

NOTE — This method is not intended to replace full scale penetration as described in IS 1448 [P : 60]. Precision is better in full scale penetration method.

5.2 Worked penetration results may be used to establish the consistency of lubricating greases within the above NLGI consistency number. The procedures in this test method are widely used for specification purposes, however, no correlation with field performance has been established.

6 APPARATUS

6.1 Penetrometer

An instrument similar to that shown in Fig. 1 of IS 1448 [P : 60] : 1971 adopted to use with 1/4 scale or 1/2 scale cones.

NOTE — Any slight bending in the instrument may produce a significant error in penetration values. Periodic check of the release mechanism, cone dimensions and weight of cone and its movable attachments is recommended.

6.2 One Quarter Scale Cone and Shaft

The cone shall be made of plastic with hardened steel tip of 45 to 50 HRC and shall be constructed to conform to the dimensions and tolerances shown in Fig. 1. The shaft may be made of magnesium. The total mass of the cone and the shaft shall be 9·38 ± 0·025 g. The total mass of the cone and its movable attachments may be adjusted by adding small shot to the cavity to the shaft.

6.3 One Quarter Scale Grease Worker

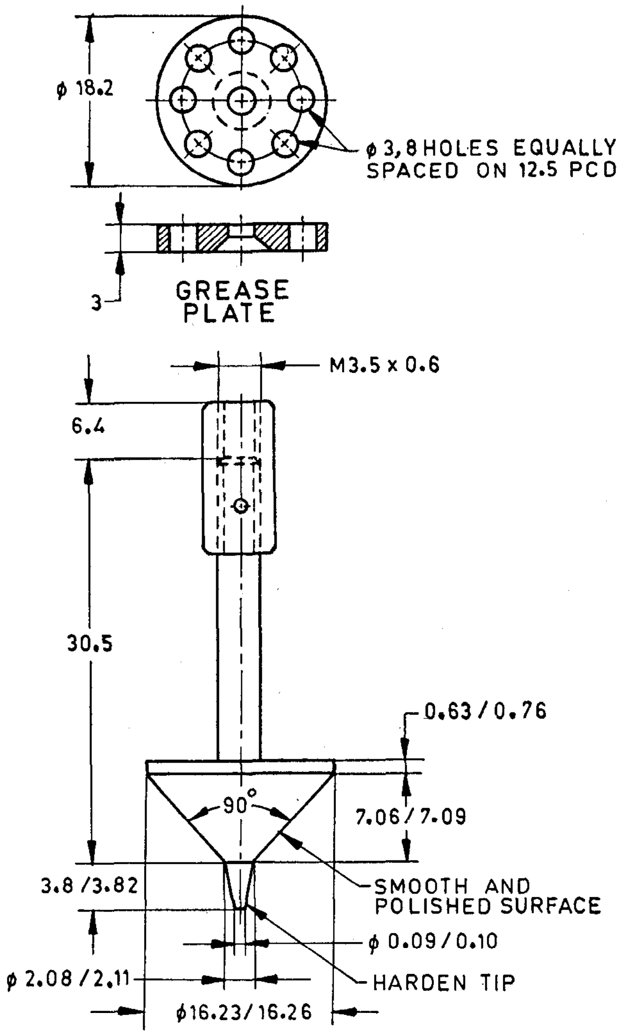
Conforming to the dimensions shown in Fig. 2. Other methods of fastening the cover and securing the worker may be used. The worker may be constructed for either manual or mechanical operation. Design shall be such that a rate of 60 ± 10 strokes per minute, with a minimum length of 14 mm may be maintained.

6.4 One Half Scale Cone and Shaft

The cone shall be made of steel, stainless steel or brass with the tip of 45 to 50 HRC and shall be constructed to confirm to the dimensions and tolerances shown in Fig. 3. The shaft may be made of stainless steel. The total mass of the cone and its movable attachments shall be 37·5 ± 0·05 g. The mass of the cone shall be 22·5 ± 0·025 g. The mass of the movable attachments shall be 15 ± 0·025 g.

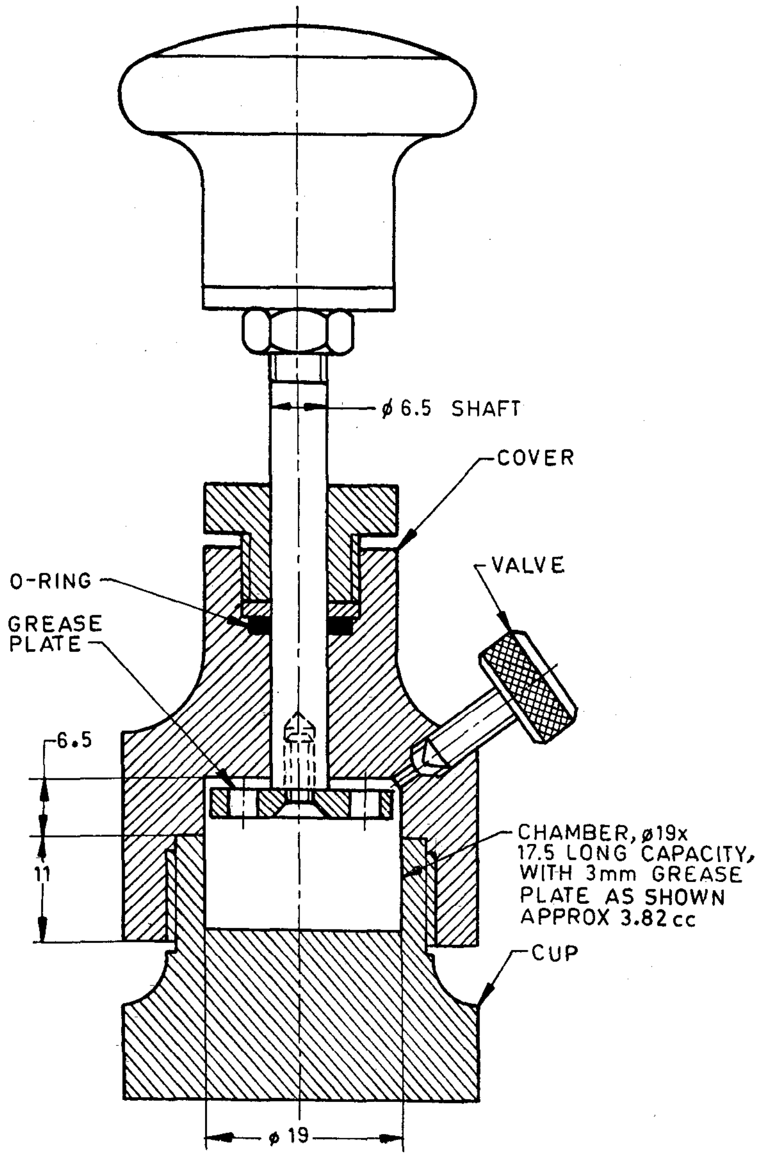
6.5 One Half Scale Grease Worker

Worker shall conform to the dimensions given in Fig. 4. Other methods of fastening the cover and securing the worker may be used. The worker may be constructed for either manual or mechanical operation. Design shall be such that a rate of 60 ± 10 strokes per minute, with a minimum length of 35 mm may be maintained.



All dimensions in millimetres.

FIG. 1 ONE-QUARTER SCALE CONE AND SHAFT


ϕ 6.5 SHAFT
COVER
VALVE
O-RING
GREASE PLATE
6.5
11
CHAMBER, ϕ19x 17.5 LONG CAPACITY, WITH 3mm GREASE PLATE AS SHOWN APPROX 3.82 cc
CUP
ϕ 19

All dimensions in millimetres.

FIG. 2 ONE-QUARTER SCALE GREASE WORKER

6.6 Water Bath

Capable of regulating to 25 ± 0·5°C and designed to bring the assembled grease worker to test temperature conveniently.

NOTE — A constant temperature test room may be used instead of water or air bath.

6.7 Spatula

Of corrosion resistant steel, having a stiff blade 13 mm in width and convenient in length, with its end cut square.

6.8 Timer

Registering to 0·1 seconds.

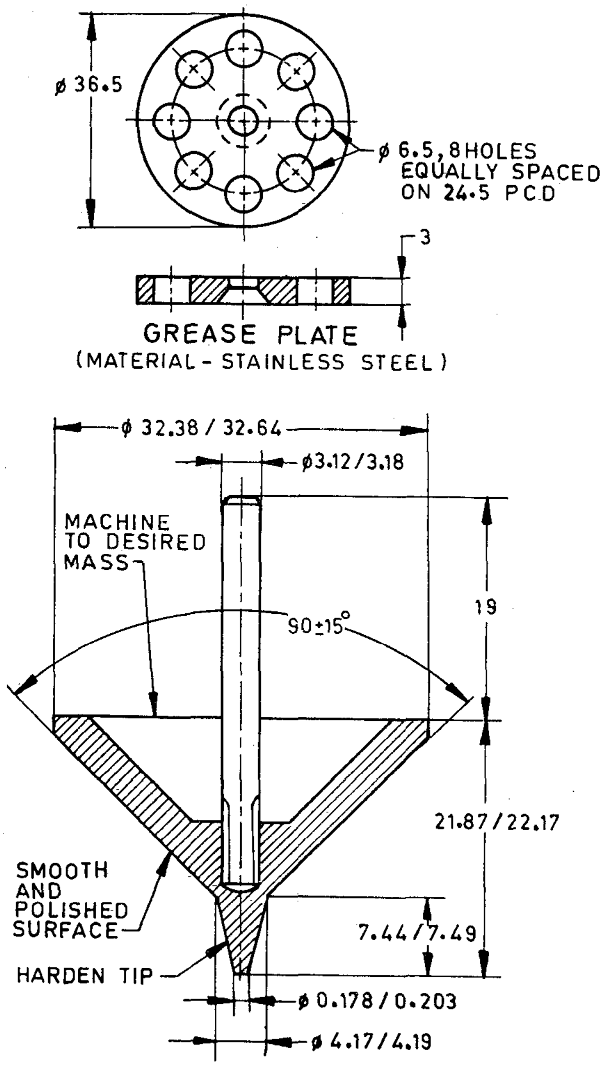
7 PROCEDURE FOR UNWORKED PENETRATION

7.1 Sample

Sufficient sample to overfill the cup of the grease worker shall be required. If the penetration by 1/4 scale is greater than 47 or by 1/2 scale greater than 97, at least three times the amount needed to fill the cup shall be required as only one result can be obtained in one grease cup.

7.2 Preparing Sample for Measurement

If necessary place the assembled greae worker or metal container of equal inside dimensions and an appropriate amount of sample in a metal container in the water bath (*see* Note under **6.6**)



All dimensions in millimetres.

FIG. 3 HALF-SCALE CONE

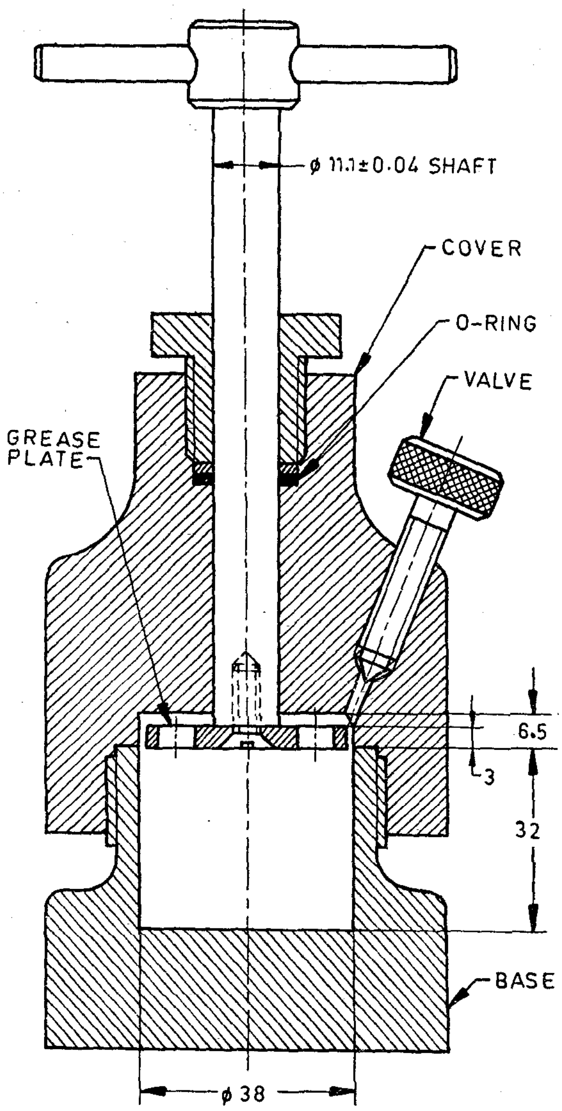
long enough to bring the temperature of the sample to 25°C ± 0.5°C. Transfer from the container a portion of sample, preferably in one lump to overfill the cup of the grease worker or metal container of equal inside dimensions. Make this transfer in such a manner that the grease will be worked as little as possible. Jar the container to drive out trapped air, and pack the grease with the spatula, with as little manipulation as possible, to obtain a cupful without air pockets. Scrap off the excess grease by moving the blade held inclined towards the direction of motion at an angle of 45°, across the rim of the cup. Do not perform any further levelling or smoothing of the surface throughout the determination of the unworked penetration.

7.3 Cleaning Cone and Shaft

Clean the penetrometer cone carefully before each test. Bending of the cone shaft can be avoided by holding it securely in its raised position while cleaning. Do not permit grease or oil on the penetrometer shaft, as this can cause drag on the shaft assembly. Do not rotate the cone, as this may cause wear on the release mechanism.

7.4 Penetration Measurement

Place the cup on the penetrometer table making certain that it can not teeter. Set the mechanism to hold the cone in the zero position and adjust the apparatus carefully so that the tip of the cone just touches the surface at the centre of the test sample. Watching the shadow of the cone tip is an aid to accurate setting. Release the cone shaft rapidly, and allow it to drop for 5.0±0.1 seconds. The release mechanism should not drag on the shaft. Gently depress the indicator shaft until stopped by the cone shaft and read the penetration from the indicator.



All dimensions in millimetres.

FIG. 4 HALF-SCALE GREASE WOREKR

7.4.1 If the sample has a penetration over 47 by 1/4 scale or over 97 by 1/2 scale, centre the cone carefully in the container; this sample can then be used for only one test. If the sample has a penetration of 47 or less by 1/4 scale or 97 by 1/2 scale, perform three tests in a single container spacing these tests on three radii 120 deg apart and midway between the centre and side of the container so that the cone will neither strike the side of the container nor impinge on disturbed area made in a previous test.

7.5 Additional Testing

Make a total of three tests on sample (either in three containers or in one), as described in **6.4** and report the average value, to the nearest 0·1 mm, as the unworked penetration of the sample.

8 PROCEDURE FOR WORKED PENETRATION

8.1 Sample

Sufficient sample to overfill the cup of the appropriate grease worker shall be required.

8.2 Working

Transfer sufficient sample to the cup of the clean grease worker to fill it heaping full, mounded up about 6 mm at the centre, avoiding the inclusion of air by packing with the spatula. Jar the cup from time to time as it is being packed to remove any air inadvertantly entrapped. Assemble the worker and, with the vent cock open, depress the plunger to the bottom. Close the vent cock and place the assembled worker in the water or air bath maintained at 25°C to bring the temperature of the grease to 25 ± 0·5°C. Then remove the worker from the bath and wipe off any water adhering to its surfaces. Subject the grease to 60 full double strokes of the plunger, completed in 1 min ±5 seconds and return the plunger to its top position. Open the vent cock, remove the top and plunger, and return to the cup as much of the grease clinging to the plunger as may readily be removed. As the worked penetration of a lubricating grease may change significantly on standing, proceed in accordance with **8.3**, **8.4** and **8.5** immediately.

8.3 Preparing Sample for Measurement

Prepare the worked sample in the cup for testing so that a uniform and reproducible structure of grease would be obtained. Jar the cup sharply on the bench or floor and pack the grease down with a spatula to fill the holes left by plunger and to remove any air pockets. Scrap off the excess grease extending above the rim of the cup by moving the blade of the spatula, held inclinded towards the direction of motion at an angle of 45° across the rim of the cup retaining the portion removed.

NOTES

1 The jarring should be vigorous as required to remove the entrapped air without splashing the sample from the cup. In performing these operations, a minimum of manipulation should be used as an agitation of the grease may have the effect of increasing the working beyond the specified 60 strokes.

2 Particularly when testing soft greases, retain the grease removed from the cup in a scrapping to provide a full cup for subsequent tests. Keep the outside of the rim of the cup clean so that the grease forced by the penetrometer cone to overflow the cup may be returned to the cup prior to preparing the sample for the next test.

8.4 Penetration Measurement

Determine the penetration of the sample as described in **7.3**, **7.4** and **7.4.1**.

8.5 Additional Tests

Immediately make two more tests in succession on the same sample, returning to the cup the portion previously removed with the spatula; repeat the operations described in **8.3** and **8.4**. Report the average of the three tests, to the nearest unit, as the worked penetration of the sample.

9 CALCULATIONS

9.1 When required, the penetration values obtained from the 1/4 scale and 1/2 scale cone equipment in **7.5** and **8.5** may be converted to full scale penetrations IS 1448 [P : 60] by following equation.

9.1.1 1/4 *Scale*

$$P = 3{\cdot}75\, p + 24$$

where

P = cone penetration by Method IS 1448 [P : 60], and

p = cone penetration by 1/4 scale equipment.

NOTE — Full-scale penetration values derived from the 1/4-scale conversion equation in **9.1.1** may differ from those obtained using IS 1448 [P : 60] test method. Parties interested in using full-scale penetration values converted from 1/4-scale results may use a modified conversion equation when mutually agreeable.

9.1.2 1/2 *Scale*

$$P = 2\,r + 5$$

where

P = cone penetration by Method IS 1448 [P : 60], and

r = cone penetration by 1/2 scale equipment.

10 PRECISION AND BIAS

10.1 The precision of this method is not known to have been obtained in accordance with currently accepted guidelines.

10.2 Results of duplicate tests shall not differ by more than the following amounts:

	Repeatability		*Reproducibility*	
	¼ Scale	½ Scale	¼ Scale	½ Scale
Unworked	3	5	10	13
Worked	3	3	7	10

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